2011 Biennial Report to Congress on the Progress and Findings of Studies of Striped Bass Populations

Submitted to the:
Committee on Resources of the
United States House of Representatives
and
Committee on Commerce,
Science, and Transportation
of the United States Senate

Submitted by:
National Marine Fisheries Service
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U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

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LIST OF ACRONYMS

ACCSP	Atlantic Coastal Cooperative Statistics Program
ASMFC	Atlantic States Marine Fisheries Commission
CPUE	Catch Per Unit of Effort
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
F	Fishing Mortality Rate
FMP	Fishery Management Plan
FWS	U.S. Fish and Wildlife Service
ISFMP	Interstate Fisheries Management Program
MSY	Maximum Sustainable Yield
mt	metric tons
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	Optimal Yield
SARC	Stock Assessment and Review Committee
SAW	Stock Assessment Workshop
SEAMAP	Southeast Area Monitoring and Assessment Program
SSB	Spawning Stock Biomass

DEFINITIONS

Commission: Unless otherwise noted, refers to the Atlantic States Marine Fisheries Commission.

Committee: Unless otherwise noted, refers to the Atlantic States Marine Fisheries Commission's Atlantic Striped Bass Technical Committee.

Striped Bass: Refers to migratory Atlantic striped bass (*Morone saxatilis*).

Striped Bass Act: Refers to the Atlantic Striped Bass Conservation Act as amended in 1997.

EXECUTIVE SUMMARY

Introduction

The 1997 reauthorization of the Atlantic Striped Bass Conservation Act (Striped Bass Act) mandated biennial reports to Congress and to the Atlantic States Marine Fisheries Commission (Commission) from the secretaries of the Department of Commerce and the Department of the Interior concerning the progress and findings of studies of migratory Atlantic striped bass (*Morone saxatilis*). The Striped Bass Act specifically requests updates on studies that include, but are not limited to: annual stock assessments, investigations on the causes of fluctuations in migratory Atlantic striped bass populations, the effects of environmental factors on the recruitment, spawning potential, mortality, and abundance of migratory Atlantic striped bass populations, and investigations of interactions between migratory Atlantic striped bass and other fish. This document is the sixth such report to Congress and includes data available through 2011 with emphasis on the 2009 and 2010 calendar years.

Status of the Stock

- Migratory striped bass are not overfished.
- Overfishing is not occurring on migratory striped bass.
- Total commercial catch (landings and dead discards) in 2009 and 2010 were 1.60 million and 1.28 million fish, respectively.
- Total recreational catch (landings and dead discards) in 2009 and 2010 were 2.64 million and 2.50 million fish, respectively.
- Total migratory striped bass harvest (commercial and recreational catch and discard) in 2009 and 2010 is estimated at 4.2 million fish and 3.8 million fish, respectively. The 2009 and 2010 harvests are below the two previous years.

Habitat and Environmental Quality

- In January 2009 the Atlantic States Marine Fisheries Commission published: Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs (available online at: http://asmfc.org/habitat.htm). The striped bass chapter includes: 1) Description of striped bass habitat; 2) The identification and distribution of striped bass habitat areas of particular concern; 3) Present condition of habitat; and 4) Significant environmental, temporal, and spatial factors affecting the distribution of striped bass.

Management Changes

- Although there has been a change in the Presidential administration, the regulation of striped bass has remained status quo. Former President Bush's Executive Order (E.O. 13449, October 20, 2007) prohibiting the sale of striped bass caught in the EEZ remains in effect.
- The Commission's Addendum I to Amendment 6 of the Striped Bass Interstate Fisheries Management Plan (November 2007) also remains in effect.

- The Commission adopted new biological reference points as recommended by the 46th Northeast Regional Stock Assessment Review Committee in 2008.
- The Commission adopted Addendum II to Amendment 6 of the Striped Bass Interstate Fisheries Management Plan in November 2010, which modified the definition of recruitment failure. Identifying periods of recruitment failure is the basis of the juvenile abundance index management trigger in Amendment 6. This trigger is used to evaluate when management action is needed to ensure a healthy population of striped bass.
- The Commission adopted Addendum III to Amendment 6 of the Striped Bass Interstate Fisheries Management Plan in August 2012. Addendum III requires mandatory tagging of all commercially caught striped bass in states and jurisdictions with a commercial fishery prior to the start of the 2013 commercial striped bass fishing year.

Conclusions

Atlantic migratory striped bass stocks have remained stable over the past several years. Total abundance has declined since 2004 resulting in lower total catches in 2009 and 2010 than in the previous two years. Striped bass stocks are at moderate levels of abundance and the stock is not overfished, nor is overfishing occurring. In 2009 and 2010, recruitment (age 1 fish abundance) remained below the median for the restored stock. The stock continues to be fished at levels below the reference points detailed in the current fishery management plan. It is expected that catches will increase in 2011 but decline through 2017 based on projections of 8-year and older striped bass, assuming recent fishing mortality and recruitment rates continue. Studies documenting striped bass habitat requirements at all life stages are continuing. The completion of a comprehensive documentation and review of utilization, threats, recommendations for conservation, and research needs for Atlantic striped bass habitat was completed in 2009. Disease in striped bass continues to be of concern, but studies are continuing to make progress on identifying the impacts and causes. At this time, current studies regarding Atlantic striped bass are providing important data to successfully manage this fishery. A benchmark stock assessment is scheduled for 2013.

INTRODUCTION

In response to precipitous declines in Atlantic striped bass landings during the 1970s, Congress passed, and President Carter enacted, an amendment (P.L. 96-118) to the Anadromous Fish Conservation Act in 1979. The amendment specified that an Emergency Striped Bass Study be conducted to determine the status of striped bass stocks and causes for the decline in striped bass populations. This study was conducted each year from 1980 through 1994, and a report was submitted to Congress presenting results of the various research activities that were a part of the study. The last such report was prepared in 1995 for the 1994 study year. In 1981 the Atlantic States Marine Fisheries Commission (Commission) developed a coastwide management plan for Atlantic striped bass to be implemented by its member states. In 1984 Congress passed, and President Reagan enacted, the Atlantic Striped Bass Conservation Act (Striped Bass Act) to support and encourage the development, implementation, and enforcement of the interstate fisheries management plan for Atlantic striped bass. When the Striped Bass Act was amended in 1997, it mandated that the Secretaries of Commerce and the Interior provide biennial reports to Congress and the Commission on studies of the Atlantic striped bass resource.

The Commission maintains an Atlantic Striped Bass Technical Committee (Committee) comprised of state, federal, Commission, university and/or other specialized personnel with scientific and technical expertise and knowledge of the striped bass fishery. The Committee principally reviews the status of the stock and other technical assignments per the request of the Commission's Atlantic Striped Bass Management Board on a regular basis. Data for stock assessments and other analyses are collected and submitted by individual states, NOAA's National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (FWS) for use by the Committee.

STATUS OF THE STOCK

In 2011 the Commission's Striped Bass Technical Committee updated the 2007 benchmark stock assessment report with data through 2010 and determined that the estimated female spawning stock biomass (SSB) was 109% of the target and 137% of the SSB threshold. Estimated fishing mortality rates were 0.23 or less, below both the target and threshold values.

Commercial Catch

Commercial catch (landings and dead discards) in 2009 totaled 1.60 million fish, nearly equal to the average 2007 and 2008 catch. The 2010 catch declined to 1.28 million fish. Commercial landings have remained fairly steady over the past 10 years (Tables 1-2). Most of the commercial landings come from the states of Maryland and Virginia, which together account for approximately 72% of the commercial catch in 2009 and 2010. Table 3 details state landings data.

Recreational Catch

Estimated recreational catch (landings and dead discards) in 2009 totaled 2.64 million fish, which was the lowest since 1999. The 2010 estimated catch further decreased to 2.50 million fish. Hook and line discard mortality is currently estimated at 8% of released fish; however the Committee is considering whether to modify this value for the upcoming benchmark assessment. Recreational landings occur primarily in the states of Massachusetts, New York, New Jersey, Maryland, and Virginia. Maryland's 2010 estimated recreational landings decreased by over 60,000 fish from 2009 to an estimated 469,161 fish landed, leaving it second to New York in total fish landed. It is expected that catches will increase in 2011 but decline through 2017 based on projections of 8-year and older striped bass, assuming recent fishing mortality and recruitment rates continue.

Trends in Stock Size

Overall, since 2003 fishing mortality continues to have modest increases while spawning stock biomass (SSB) and abundance have declined (Table 4, Figure 6). However, it is expected that consistent recruitment into the fishery, punctuated by the exceptional 2003 year class (the largest year class since at least 1982), will offset declines in abundance and SSB through 2011 but catch is expected to decline thereafter through 2017. The 2008 year class (age 1 in 2009) was slightly below the recent average while the 2009 cohort was about average. It is also important to note that SSB and fishing mortality remain well within the targets and thresholds of the fishery management plan as recently updated, thus no additional management action is warranted at this time (Table 5, Figure 7).

HABITAT AND ENVIRONMENTAL QUALITY

Studies on striped bass habitat use and environmental quality have continued during the 2009-2010 time period. The U.S. Fish and Wildlife Service's South Atlantic Fisheries Coordination Office, in cooperation with the Commission, NMFS, and other partners, continues to gather data on nearshore striped bass abundances via the Southeast Area Monitoring and Assessment Program (SEAMAP) Cooperative Winter Tagging Cruises (Cruise). A 23-year cruise summary report is expected to be released by late 2012. A Summary Fact Sheet for the Cruise was published in 2009 (available from ASMFC or the FWS South Atlantic Fisheries Coordination Office). Selected information on striped bass habitat use on the wintering grounds off Virginia and North Carolina was provided in the 2007 stock assessment document. Due to the lack of funding for research vessel operations, striped bass tagging off NC and VA was conducted using hook-and-line gear from charter fishing vessels in 2011 and 2012. Funding has been secured for reinitiating the Cruise in 2013, when both trawl and hook-and-line capture methods will be employed in order to compare the two tagging approaches.

Catch data from the 2007-2010 Cruises indicated that migratory striped bass distribution during winter off the coast of VA and NC appears to be shifting northward

and offshore. Striped bass have been consistently caught further north, and/or further offshore of the positions where fish were most often captured during 1988-2006. A detailed analysis of the entire dataset is currently being conducted to assess what factors may be causing the distribution shift.

Additional insight into migratory striped bass habitat use is being provided through the use of acoustic tags. Dr. Ken Able and students have implanted acoustic tags in adult migratory striped bass and have learned a great deal about the behavior and habitat use of individual fish (see http://www.stripertracker.org/; also see Able et al. 2007, Ng et al. 2007, and Grothues et al. 2009). Striped bass with the tags are detected by receivers placed at various locations along the U.S. East Coast, enabling determination of their migratory patterns and residence time in specific habitats. The initial pilot studies have been completed and proposals are pending to move to a new study phase.

In January 2009, the Commission, in partnership with the FWS, NMFS, and West Virginia University, prepared and published: Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs. This comprehensive volume has a chapter on striped bass that includes: 1) Description of striped bass habitat; 2) The identification and distribution of striped bass habitat areas of particular concern; 3) Present condition of habitat; and 4) Significant environmental, temporal, and spatial factors affecting the distribution of striped bass. This publication will greatly enhance the ability of scientists and managers to locate in one place a full accounting a striped bass habitat. The publication is available online at the ASMFC web site (http://www.asmfc.org/habitat.htm).

Striped Bass Health

Disease issues continue to be an area of concern for striped bass. Specifically, a chronic, progressive bacterial disease known as mycobacteriosis is affecting a large proportion of adult fish, primarily in Chesapeake Bay. The disease is caused by several species of the genus *Mycobacterium.* Symptoms in striped bass include visceral lesions, appearing grossly as greyish-white nodules (granulomas) predominantly found in the spleen and kidney, and external lesions. The issue has been under investigation by area researchers since 1996, however many questions still remain.

Mycobacteriosis has been affecting striped bass since at least 1984, based on available archived tissues (Jacobs et al. 2009a). However, the current high prevalence of disease (~50-70%) in adult Chesapeake Bay striped bass has led to much public concern. Multiple survey and experimental efforts conducted by state, federal and academic researchers suggest the following:

1) The prevalence of mycobacteriosis in adult (3-6 year old) striped bass showed a slight decrease in 2011 compared to 2010 and 2009 but remained within the historical range of 40% (age 3) to approximately 60% (age 6) in fish sampled in the Maryland portion of the Chesapeake Bay (Maryland Department of Natural Resources 2011).

2) Disease development is age dependent with prevalence increasing through approximately age 5 in Chesapeake Bay (Rhodes et al. 2004, Gauthier et al. 2008.

Maryland Department of Natural Resources (2011) reported an increase in infection rates from 0.5% of age 0 fish to 65% in age 6 striped bass.

3) Mycobacteriosis is a chronic disease that is generally considered to be irreversible. Tag studies (Sadler et al. 2011) were used to estimate the rates of disease progression in infected striped bass. Progression from a light to moderate level of infection was shown to take place in 100% of the population within 386 days while progression from moderate to severe infection was estimated to be 753 days.

4) Efforts using force of infection models suggest that there may be significant mortality associated with this disease. Initial estimates suggest the probability of survival of infected striped bass may be reduced to 69% of un-infected cohorts (Gauthier et al. 2008). Tag return studies demonstrate that survival rates decline to 91%, 68%, and 55% in striped bass characterized as having mild, moderate, or severe stages of infection, respectively, when compared to striped bass with no outward signs of disease (Sadler et al. 2011).

5) Growth models indicate that disease may negatively impact striped bass growth potential with disease-positive fish growing slower and obtaining lower maximum length than disease-negative fish (Latour et al. 2012). These differences in growth are most pronounced in striped bass exhibiting advanced signs of disease. Similar reductions in growth and condition in severely infected fish have been previously documented (Maryland Department of Natural Resources 2011; Overton et al. 2003). Reduced growth may negatively impact total biomass and recruitment but the relationship between disease and production of the fishery is currently unclear.

6) Limited efforts outside of Chesapeake Bay have demonstrated the disease is present, but at lower prevalence in Delaware Bay (Ottinger et al. 2007), Roanoke River and Albermarle Sound, NC (Overton et al. 2006), Hudson River (Mark Fast, SUNY Long Island, Personal Communication), and the coastal migratory stock (Matsche et al. 2010);

7) Multiple species of Mycobacteria are involved, however their relative roles are not fully understood (Rhodes et al. 2004, Stine et al. 2009). The predominant isolate, *M. shottsii*, has also been isolated from Hudson River and Roanoke River striped bass, as well as Chesapeake Bay white perch (*Morone americana*) (Stine et al. 2010). Some of the species isolated are capable of infecting humans.

8) At least one of the primary pathogenic species, *M. pseudoshottsii*, is ubiquitous throughout the Cheasapeake Bay in both water and sediment and has been detected in the primary prey of striped bass, Atlantic menhaden and bay anchovy (Gauthier et al 2010). The ubiquitous nature of the pathogen provides a readily available reservoir for continued infection of striped bass. Therefore factors that regulate disease susceptibility and progression require further study.

9) Stressors such as poor water quality or fish nutrition may play a role; however, limited data are available addressing these hypotheses in wild fish. Poor fish nutrition has been demonstrated to enhance the severity and progression of disease in laboratory studies (Jacobs et al. 2009b). Projects designed to elucidate the role of environmental stressors (hypoxia and high temperature) are currently being conducted.

While several individual research projects are addressing components of this issue, the major effort currently underway is a large-scale tagging study led by the Virginia Institute of Marine Sciences and the Maryland Department of Natural Resources. This approach will allow for an improved understanding of the progression of this disease as well as refining estimates of disease-associated mortality. Additional mortality to the stock resulting from mycobacteriosis may be incorporated into the current benchmark assessment model.

Human Health Risks

Non-tuberculous mycobacteria infections such as those found in striped bass pose a limited health risk to immunocompetent humans. Disease may be of particular concern to anglers and commercial fisherman who likely face higher rates of contact with diseased fish relative to the general population. Unlike *M. tuberculosis*, which can lead to fatal lung infections, human infection with non-tuberculous *Mycobacterium spp.* found in striped bass is generally limited to the skin (Collins et al. 1985). Systemic infection with *M. marinum*, the most common human NTM, is rare (Parent et al. 1995). Infection is usually established following contact with the bacteria on open wounds or abrasions. Although non-fatal, these infections can be persistent and require antibiotic treatments lasting weeks to months to completely eradicate. During the ten year span of 1995-2005, 275 cases *of M. marinum* infection were reported in Virginia and Maryland (Panek and Bobo 2006) where they occurred predominantly in adult males (age 40-70) in counties adjacent to the Chesapeake Bay. All infections were contained to the patients' skin predominantly on the hands and fingers.

Consumption of striped bass poses minimal risk for mycobacteria infections in humans. Maryland Department of Natural Resources (MD DNR) guidelines recommend that anglers take precautions when handling diseased fish including the use of protective gloves, coverage of open wounds, and proper hand washing. Consumers should avoid eating fish with visible skin lesions or darkened patches on the fillet. Properly cooked striped bass poses little to no risk of mycobacteria infection to humans. Both MD-DNR and the Maryland Department of Health and Mental Hygiene do not recommend consumption of raw striped bass.

STATUS OF MANAGEMENT

Atlantic striped bass management is based on the Atlantic Striped Bass Interstate Fishery Management Plan (FMP) of the Commission. The 14 coastal jurisdictions (12 States from Maine through North Carolina, Washington D.C. and the Potomac River

Fisheries Commission), NMFS and FWS have principal management responsibility under this FMP. The ASMFC Striped Bass FMP, first adopted in 1981, has undergone six amendments through 2011. The initial FMP and its first four amendments provided a series of management measures that led to the rebuilding of the Atlantic striped bass stocks. In addition, several states closed their state waters to fishing for striped bass during the 1980s. Amendment 4, implemented in 1989, addressed the reopening of the fishery during the initial period of stock recovery. As the status of the stock continued to improve, the adaptive strategy of Amendment 4 allowed revisions to management measures addressing the changing circumstances, through adoption of six successive Addenda to Amendment 4, during 1989-1994. In addition, in November 1990, NMFS implemented a Federal ban on the harvest and possession of striped bass in the EEZ to support efforts of the Commission and to aid in the recovery of striped bass along the east coast. In 1995, the ASMFC adopted Amendment 5 to the FMP to reopen the fishery and to reduce the likelihood of overfishing. The Commission adopted five addenda to Amendment 5 to respond to changing circumstances in the fishery. To address complexity of striped bass management, as well as several other concerns, the Commission developed, and in 2003 adopted Amendment 6 to the FMP.

Amendment 6, the current governing amendment to the FMP, introduced a control rule as a tool to determine the status of the striped bass population, establishing target and threshold values for fishing mortality rate and female spawning stock biomass. The threshold F is the fishing mortality rate that allows for maximum sustainable yield (F_{msy}). The target fishing mortality rate provides a higher long-term yield from the fishery, maintains the current high level of spawning potential and provides adequate protection to increase the number of older striped bass in the population. The female spawning stock biomass (SSB) threshold is equivalent to the size of the SSB in 1995, when the population was declared restored. The SSB target is 125% of the threshold value. These biological reference points were reviewed as part of the 2007 Stock Assessment and Review Committee's (SARC) review of the stock assessment. Specifically, the SARC recommended that the fishing mortality rate target and the female spawning stock biomass reference points be re-estimated based upon the statistical catch at age (SCA) model used in the assessment. The current estimates of the biological reference points for striped bass, as adopted by the Commission in August 2008, are in the table below. Based on the reference points, the stock is not overfished, nor is overfishing occurring. The 2011 stock assessment update indicated that female SSB is 148% of the SSB target and 185% of the threshold.

	Previous Biological Reference Points		Revised Biological Reference Points	
	Fishing Mortality Rate*	Female Spawning Stock Biomass	Fishing Mortality Rate*	Female Spawning Stock Biomass
Threshold	0.41	14,000 mt	0.34	30,000 mt
Target	0.30	17,500 mt	0.30	37,500 mt

*The target fishing mortality rate for the Chesapeake Bay and Albemarle-Roanoke stock is 0.27.

The management programs for the recreational and commercial fisheries are based on maintaining the control rule. In general, the recreational fisheries are constrained by a two fish creel limit and a 28-inch minimum size limit. Commercial fisheries are regulated with size limits and an annual quota, but the quota allocated to each jurisdiction has been restored to its average landings during the 1972-1979 base period. The management programs for the Chesapeake Bay and Albemarle Sound fisheries were granted the flexibility to implement a commercial and recreational management program that utilizes a size limit no smaller than 18 inches and does not exceed a target fishing mortality rate of 0.27. Amendment 6 continues to permit conservation equivalency, allowing states to propose different regulations as long as the overall management regime achieves the target fishing mortality rate. States are also required to carry out specific fishery-dependent and fishery-independent monitoring programs.

In October 2007, in an effort to further strengthen existing striped bass conservation and enforcement in the EEZ, President George W. Bush issued an Executive Order (E.O. 13449) stating that it is the policy of the United States to conserve striped bass for the recreational, economic, and environmental benefits. This Order encourages Federal and state management that support state designation of striped bass as a gamefish where appropriate. Additionally, this Order called for action prohibiting the sale of striped bass caught in the EEZ.

In November of 2007, the Commission adopted Addendum I to Amendment 6. The purpose of this addendum was to implement a bycatch monitoring and research program as required by Amendment 6. The monitoring program was designed to increase the accuracy of data on striped bass discards from both the commercial and recreational fisheries. This addendum also recommended an angler education program to help decrease discard mortality in the recreational fishery.

In 2010 the Commission adopted Addendum II to Amendment 6. This addendum was initiated based on recommendations of the Striped Bass Technical Committee to revise the definition for striped bass recruitment failure. Identifying periods of recruitment failure is the basis of the juvenile abundance index management trigger in Amendment 6. This trigger is used to evaluate when management action is needed to ensure a healthy population of striped bass. The definition of recruitment failure was changed to a value that is below 75% of all values in a fixed time series appropriate to each juvenile abundance index.

In 2011 the Striped Bass Management Board initiated an addendum to address illegal commercial harvest of striped bass. The addendum was initiated in response to state and federal law enforcement investigations focused on illegal harvest of striped bass in the Chesapeake Bay. These investigations resulted in over $1.6 million dollars in fines levied against 19 individuals and 3 corporations for more than one million pounds of illegal striped bass harvested. Addendum III to Amendment 6 was approved in August 2012 and implemented mandatory commercial tagging programs for all jurisdictions with a commercial fishery. The requirements of the addendum will become effective in 2013 for all jurisdictions with a commercial fishery in 2013, with the exception of Massachusetts and North Carolina. North Carolina was granted an extension due to the timing of its season, while Massachusetts lacks an established commercial tagging

program and needs additional time to develop its program. Both states will be required to implement their programs by January 1, 2014.

SUMMARY AND CONCLUSIONS

Atlantic striped bass stocks have declined in abundance since 2004 resulting in lower total catches in 2009 and 2010 than in the previous two years. However, the stock is not overfished, nor is overfishing occurring. In 2010 there was an increase in recruitment (age-1 fish abundance) over the previous year, which was below the average for the restored stock. The stock continues to be fished at levels within the bounds of the current fishery management plan. Studies documenting striped bass habitat requirements at all life stages are continuing with 2009 seeing the completion of the comprehensive documentation and review of utilization, threats, recommendations for conservation, and research needs for Atlantic striped bass habitat. Disease in striped bass continues to be of concern, but studies are continuing to make progress on identifying the impacts and causes. A new benchmark assessment will be completed and peer-reviewed during 2013. At this time, current studies regarding Atlantic striped bass are providing important data to successfully manage this fishery.

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TABLES

Table 1. Atlantic Coast landings of striped bass in metric tons and numbers from 1981 to 2010 (recreational information not available prior to 1981). Recreational data since 2004 were generated via Marine Recreational Information Program (MRIP).

Year	Commercial		Recreational		Total	
	metric tons	*number*	*metric tons*	*number*	*metric tons*	*number*
1982	992	428,630	1,144	217,256	2,135	645,886
1983	639	357,541	1,224	307,134	1,863	664,675
1984	1,104	870,871	582	117,993	1,685	988,864
1985	431	174,621	376	139,494	807	314,115
1986	63	17,681	502	115,576	565	133,257
1987	63	13,552	388	43,755	451	57,307
1988	117	33,310	578	92,499	694	125,809
1989	91	7,402	336	38,074	427	45,476
1990	313	115,636	1,010	163,242	1,323	278,878
1991	668	153,798	1,653	262,469	2,321	416,267
1992	650	230,714	1,830	300,530	2,480	531,244
1993	794	312,860	2,563	428,719	3,357	741,579
1994	806	307,443	3,083	565,671	3,889	873,114
1995	1,555	534,914	5,709	1,108,553	7,264	1,643,467
1996	1,541	766,518	6,040	1,199,957	7,581	1,966,475
1997	2,679	1,058,181	7,336	1,648,127	10,015	2,706,308
1998	2,936	1,223,828	5,850	1,457,057	8,786	2,680,885
1999	2,963	1,103,783	6,335	1,446,388	9,299	2,550,171
2000	3,038	1,057,711	8,060	2,025,113	11,099	3,082,824
2001	2,843	941,733	8,880	2,085,130	11,723	3,026,863
2002	2,740	654,062	8,449	1,973,171	11,189	2,627,233
2003	3,199	868,987	10,405	2,545,052	13,603	3,414,039
2004	3,332	907,501	12,596	2,615,629	15,928	3,523,130
2005	3,240	968,206	11,567	2,335,391	14,807	3,303,597
2006	3,073	1,049,587	13,814	2,774,542	16,887	3,824,129
2007	3,192	1,019,600	11,156	2,316,200	14,348	3,335,800
2008	3,281	1,006,701	12,310	2,235,700	15,591	3,242,400
2009	3,281	1,042,619	11,591	2,012,500	14,872	3,055,119
2010	3,203	1,033,592	10,400	1,991,000	13,603	3,024,592

Table 2. Total striped bass dead discard and harvest in numbers by fishery component, 2009 and 2010.

2009

Fishery Component	Harvest	Bycatch	Discards		Total Removals
Recreational	2,012,546	7,814,200	625,136		2,637,682
Commercial	1,042,619		558,300		1,600,919
Total	3,055,165	7,814,200	1,183,436		4,238,601

2010

Fishery Component	Harvest	Bycatch	Discards		Total Removals
Recreational	1,990,965	6,419,788	513,583		3,184,100
Commercial	1,033,592		243,000		1,276,592
Total	3,024,557	6,418,788	756,583		4,460,692

Table 3. Commercial landings, recreational landings and recreational discard losses and total (excluding commercial discards) in number (thousands of fish) for 2009 and 2010, by state.

	Commercial landings number (000s)		Recreational landings number (000s)		Recreational discards number (000s)		Total number (000s)	
	2009	2010	2009	2010	2009	2010	2009	2010
ME	-	-	53.0	18.7	19.8	15.3	72.8	34.0
NH	-	-	10.8	5.1	5.2	3.6	16.0	8.7
MA	63.9	67.8	336.5	354.2	199.2	153.8	599.6	575.8
RI	20.7	17.3	75.1	79.5	28.7	17.0	124.5	113.8
CT	-	-	72.9	87.6	102.5	62.2	175.4	149.8
NY	82.6	81.9	329.4	501.7	73.8	87.8	485.8	671.4
NJ	-	-	269.2	314.7	57.5	40.5	326.7	355.2
DE	20.7	18.6	21.8	14.8	12.2	6.3	54.7	39.7
MD	618.1	584.6	530.4	469.2	97.5	115.6	1246.0	1169.4
PRFC	89.7	90.3	-	-	-	-	89.7	90.3
VA	138.3	160.6	306.3	105.6	28.4	9.8	473.0	276.0
NC	8.7	12.7	7.4	40.0	0.3	1.7	16.4	54.4
Total	1042.7	1033.8	2012.8	1991.1	625.1	513.6	3680.6	3538.5

Table 4. Estimated population abundance, thousands at ages 1 to 13+, 1982-2010, from the 2011 catch at age model. Total in millions of fish.

	Age														
Year	1	2	3	4	5	6	7	8	9	10	11	12	13+	Total	8+
1982	2,087	1,680	1,681	1,450	472	213	165	117	90	89	77	107	58	8,286	538
1983	4,853	1,794	1,156	970	813	264	119	92	65	50	50	43	92	10,362	393
1984	4,117	4,170	1,191	626	508	425	138	62	48	34	26	26	71	11,442	267
1985	4,097	3,540	3,077	779	402	325	272	88	40	31	22	17	62	12,751	259
1986	3,686	3,520	3,010	2,552	624	310	244	199	64	29	22	15	56	14,329	384
1987	4,851	3,168	3,003	2,521	2,083	496	241	187	151	48	21	16	53	16,840	477
1988	5,630	4,172	2,714	2,549	2,113	1,723	406	196	151	122	38	17	56	19,888	580
1989	6,791	4,837	3,547	2,251	2,041	1,633	1,293	298	142	108	87	27	52	23,107	714
1990	9,588	5,839	4,133	2,987	1,857	1,649	1,296	1,014	232	110	83	67	61	28,915	1,566
1991	7,946	8,249	4,968	3,408	2,390	1,459	1,285	1,006	786	179	85	65	98	31,924	2,219
1992	8,326	6,836	7,024	4,109	2,740	1,890	1,145	1,004	785	613	140	66	127	34,805	2,736
1993	10,782	7,164	5,834	5,857	3,350	2,205	1,511	913	800	625	488	111	154	39,794	3,091
1994	21,225	9,276	6,099	4,821	4,703	2,644	1,726	1,179	711	623	487	380	206	54,079	3,585
1995	13,731	18,260	7,885	5,010	3,832	3,665	2,042	1,328	905	545	478	373	449	58,503	4,078
1996	15,664	11,810	15,444	6,360	3,859	2,873	2,712	1,503	975	664	400	350	603	63,216	4,494
1997	17,536	13,456	10,000	12,624	4,978	2,913	2,115	1,968	1,081	698	474	285	679	68,807	5,184
1998	11,054	15,059	11,355	8,087	9,688	3,656	2,076	1,481	1,363	745	479	325	661	66,028	5,054
1999	10,702	9,496	12,752	9,285	6,333	7,318	2,695	1,508	1,066	977	532	342	703	63,711	5,129
2000	8,502	9,197	8,064	10,519	7,390	4,892	5,539	2,015	1,119	789	721	392	770	59,909	5,806
2001	13,174	7,303	7,777	6,563	8,169	5,518	3,556	3,962	1,428	789	555	506	816	60,116	8,056
2002	15,662	11,318	6,188	6,372	5,160	6,203	4,092	2,600	2,873	1,031	569	399	950	63,417	8,422
2003	9,199	13,458	9,602	5,090	5,046	3,958	4,656	3,031	1,912	2,104	753	415	984	60,208	9,199
2004	20,093	7,901	11,375	7,806	3,944	3,755	2,866	3,316	2,139	1,342	1,472	526	977	67,511	9,772
2005	9,937	17,254	6,664	9,186	5,974	2,886	2,665	1,997	2,286	1,466	917	1,005	1,024	63,262	8,695
2006	7,879	8,531	14,531	5,356	6,969	4,319	2,019	1,828	1,354	1,541	985	615	1,359	57,287	7,681
2007	5,368	6,763	7,169	11,594	4,010	4,947	2,957	1,352	1,209	889	1,008	643	1,287	49,196	6,389
2008	9,342	4,608	5,692	5,749	8,763	2,884	3,439	2,014	910	809	593	671	1,283	46,756	6,280
2009	7,151	8,021	3,886	4,593	4,395	6,401	2,042	2,390	1,385	622	551	403	1,328	43,169	6,681
2010	9,099	6,140	6,762	3,133	3,506	3,204	4,523	1,416	1,640	944	423	374	1,174	42,339	5,971

Table 5. Fishing mortality average across ages 3 to 8 and ages 8 to 11, 1982-2010, from the 2011 catch at age model.

	Average F	
Year	age 3-8	age 8-11
1982	0.43	0.43
1983	0.49	0.50
1984	0.29	0.30
1985	0.12	0.19
1986	0.08	0.13
1987	0.04	0.07
1988	0.11	0.18
1989	0.07	0.11
1990	0.09	0.11
1991	0.08	0.10
1992	0.06	0.08
1993	0.08	0.10
1994	0.09	0.11
1995	0.13	0.16
1996	0.13	0.18
1997	0.16	0.22
1998	0.13	0.18
1999	0.11	0.15
2000	0.14	0.20
2001	0.12	0.18
2002	0.11	0.16
2003	0.14	0.20
2004	0.16	0.23
2005	0.17	0.25
2006	0.19	0.27
2007	0.18	0.25
2008	0.16	0.23
2009	0.17	0.23
2010	0.16	0.23

FIGURES

Figure 1. Estimated abundance and fishing mortality for striped bass age 8 and older, and total striped bass catch of fish ages 8 and older, 1982-2010. Abundance and fishing mortality estimates are derived from 2011 catch at age model results.

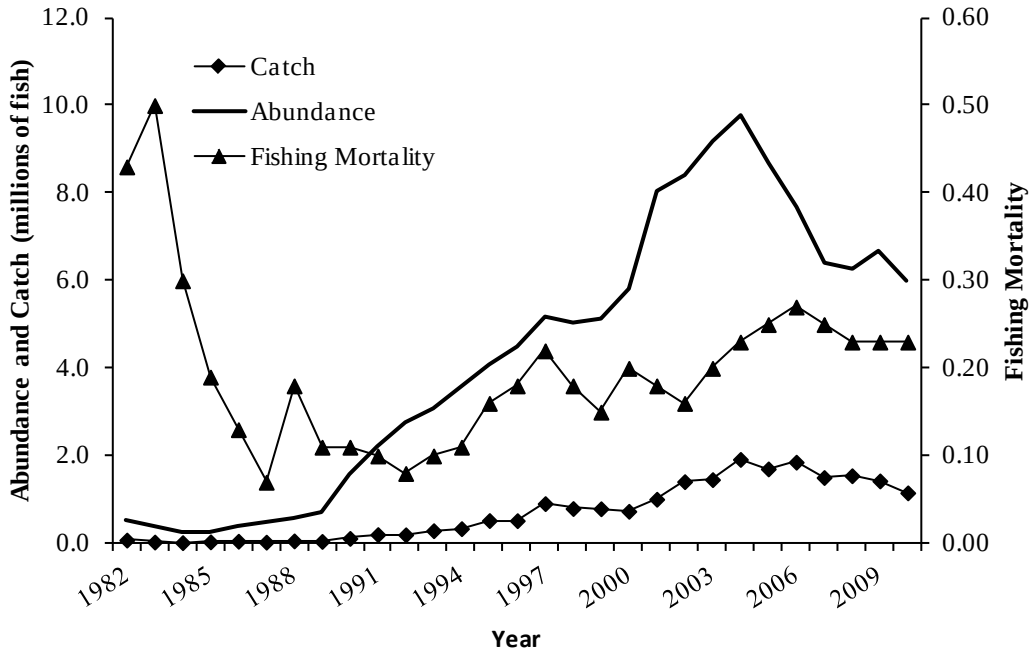
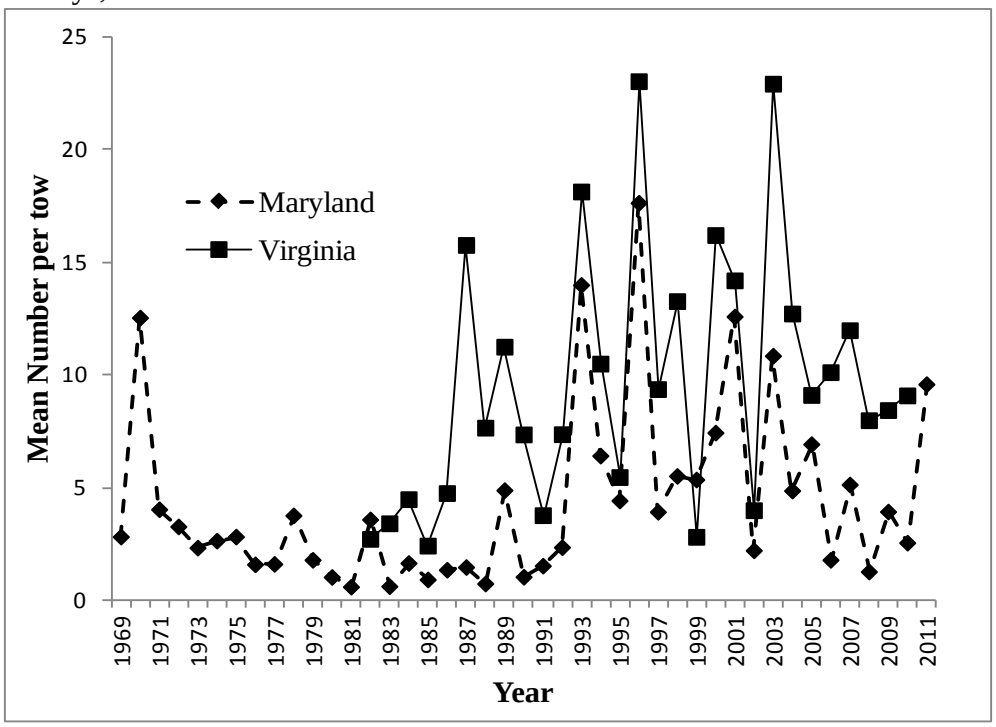


Figure 2.

a. Young of year (YOY) indices for the Chesapeake stock, Maryland and Virginia surveys, 1969 to 2011.



b. Young of year (YOY) indices for the Hudson (NY) and Delaware Bay (NJ) stocks, 1981 to 2010.

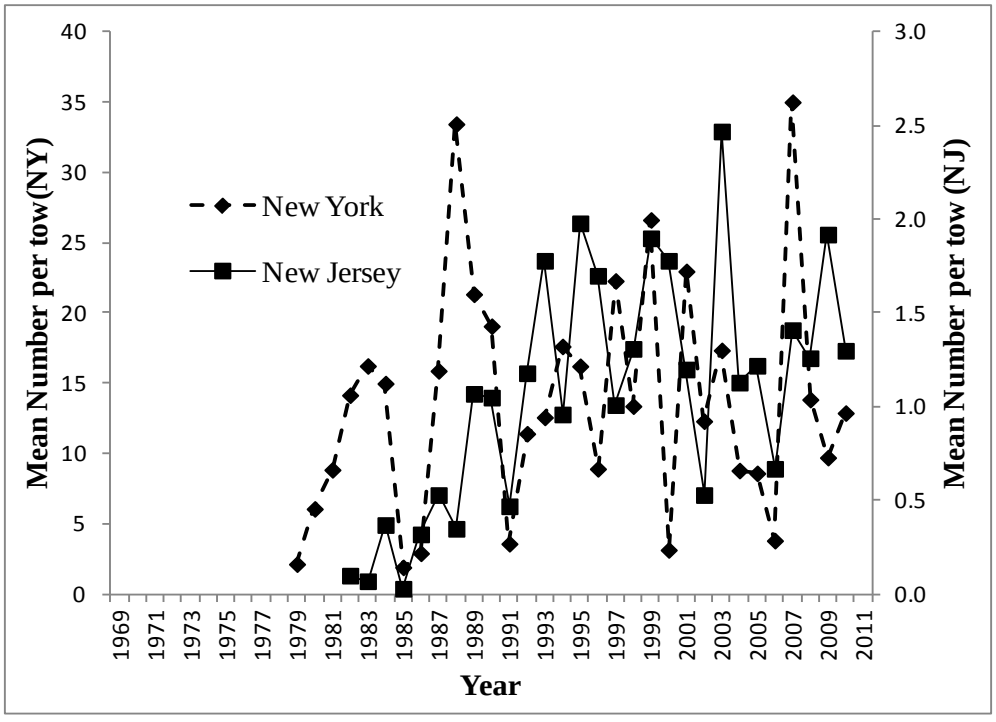
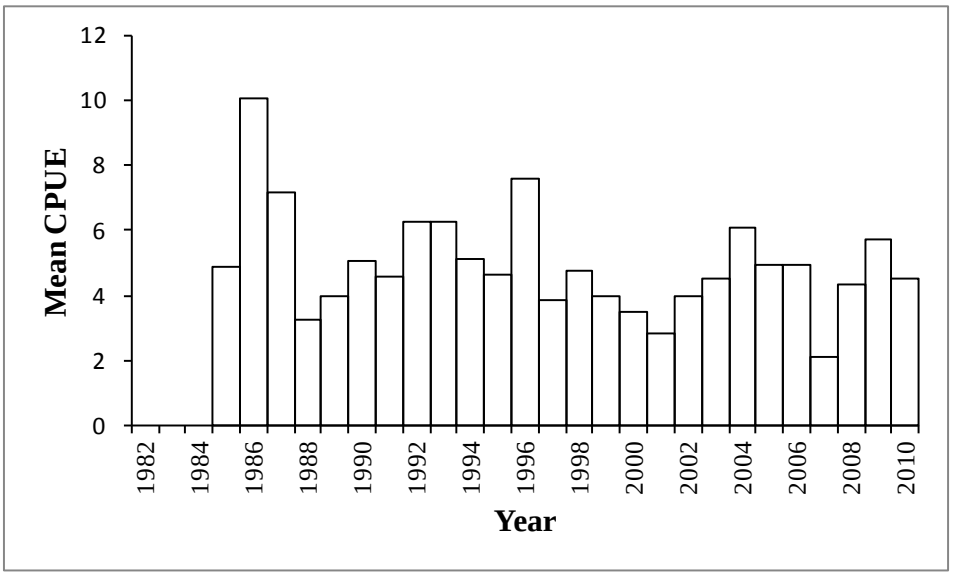
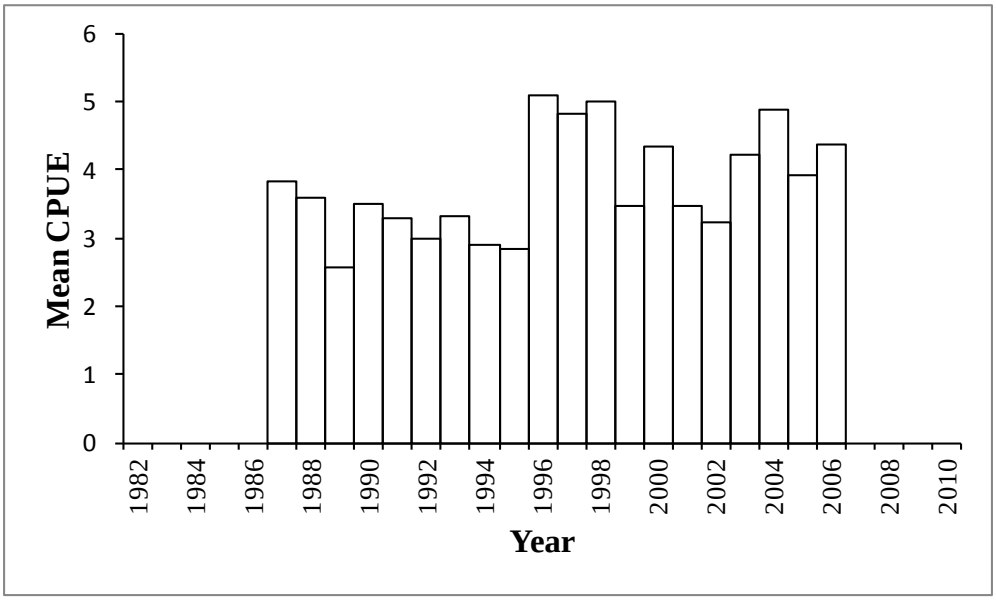


Figure 3.

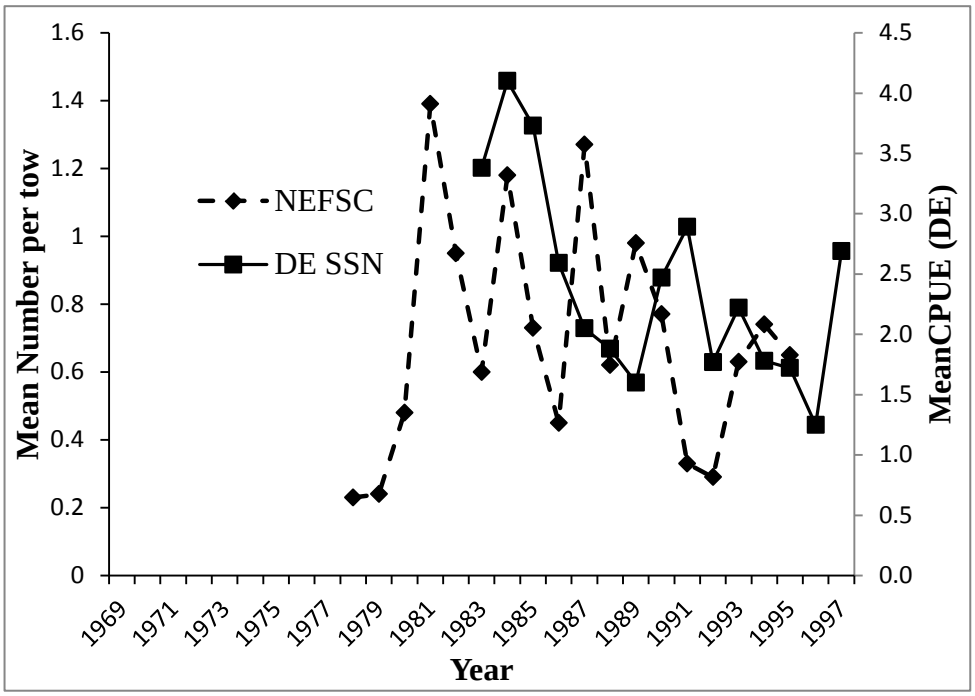
a. Maryland index of striped bass spawning stock abundance, ages 3 and older, 1985 to 2010.



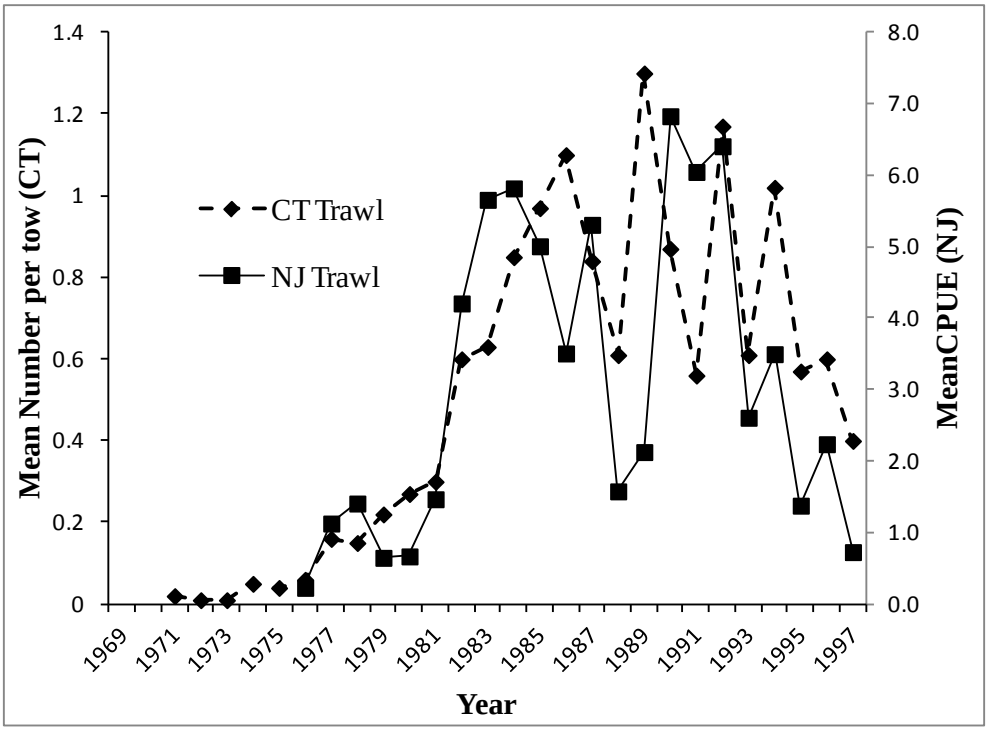
b. New York ocean haul seine index of striped bass abundance (catch per set), ages 3 and older, 1987-2006.



c. NMFS/NEFSC bottom trawl survey index of striped bass abundance (mean number per tow), ages 2 through 9; Delaware River index of spawning stock abundance (DESSN).



d. Indices of striped bass abundance from New Jersey and Connecticut trawl surveys.



e. Indices of age 1 striped bass abundance for western Long Island Sound and Maryland portion of the Chesapeake Bay.

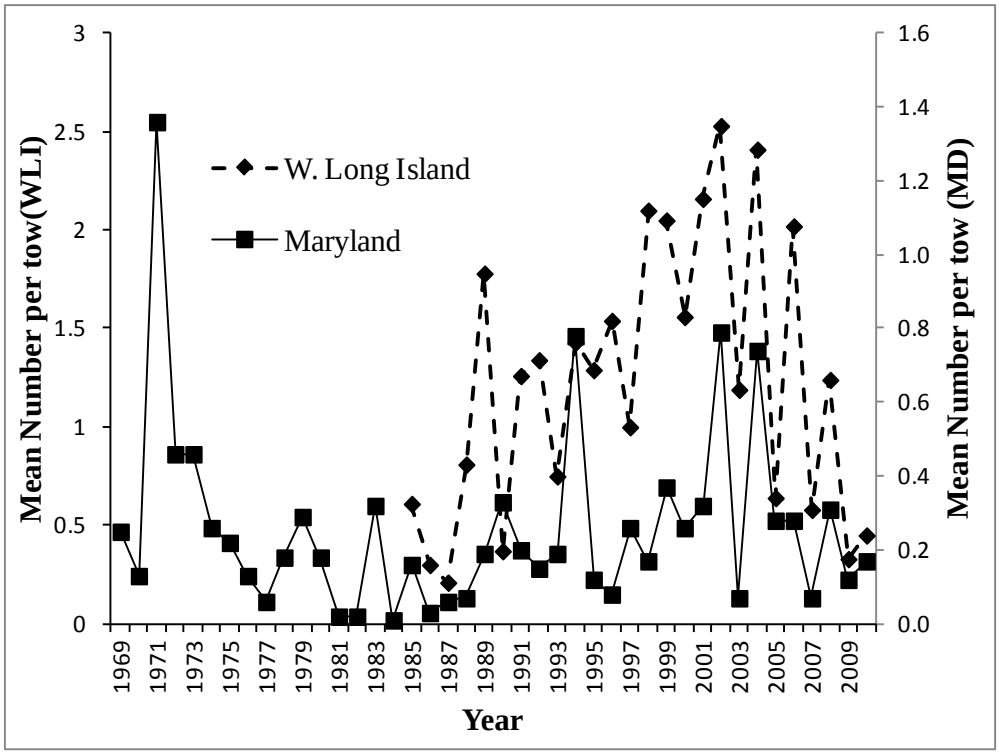


Figure 4.

Connecticut volunteer angler striped bass catch per trip for 1982 to 2010.

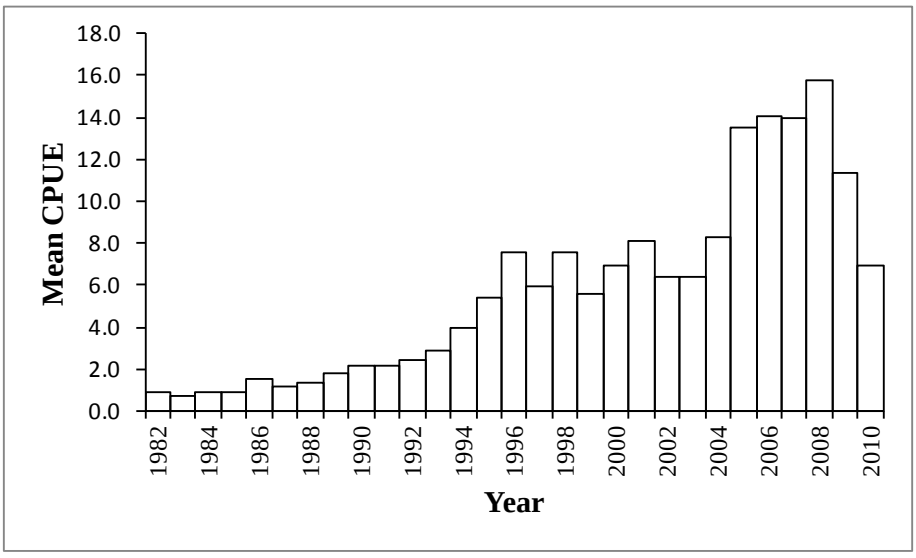
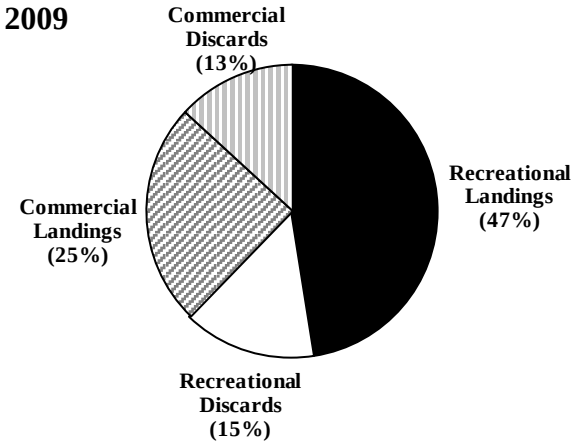


Figure 5. Percentage recreational and commercial catch (harvest and discard) in number for 2009 and 2010.



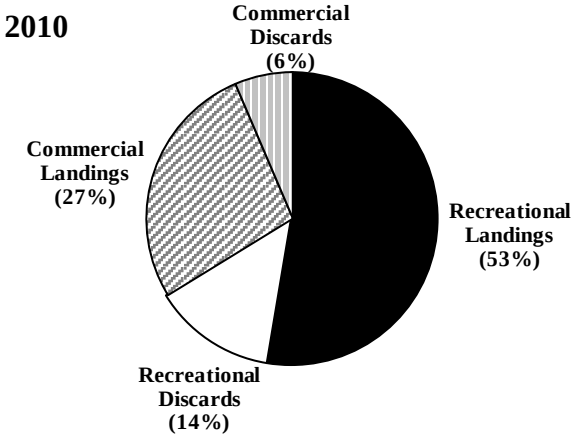


Figure 6. Striped bass population abundance (age 1 and older, and age 8 and older) from the 2011 catch at age model results.

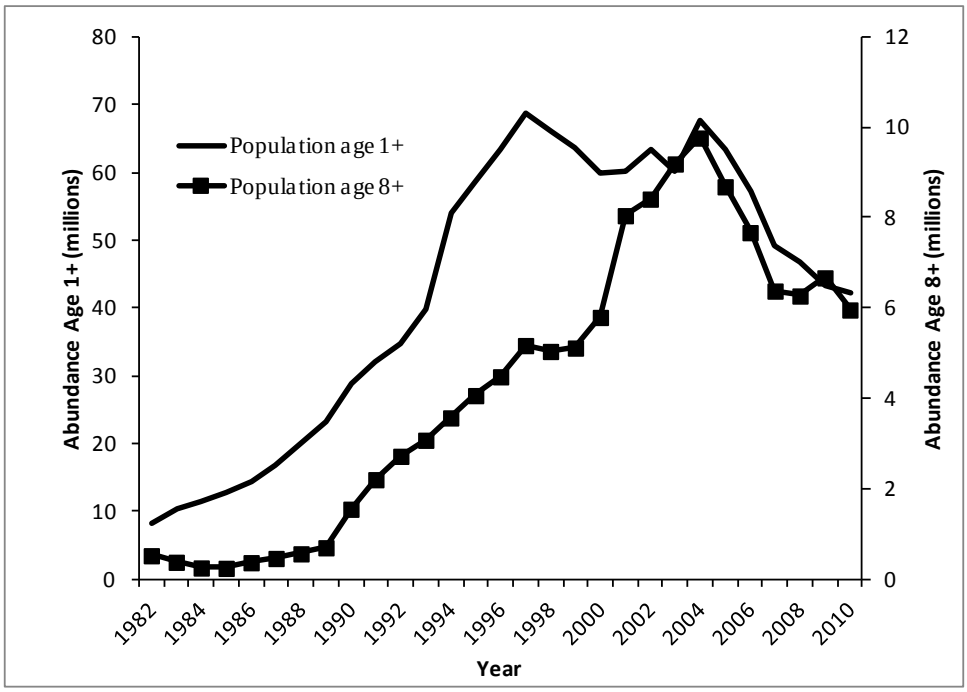
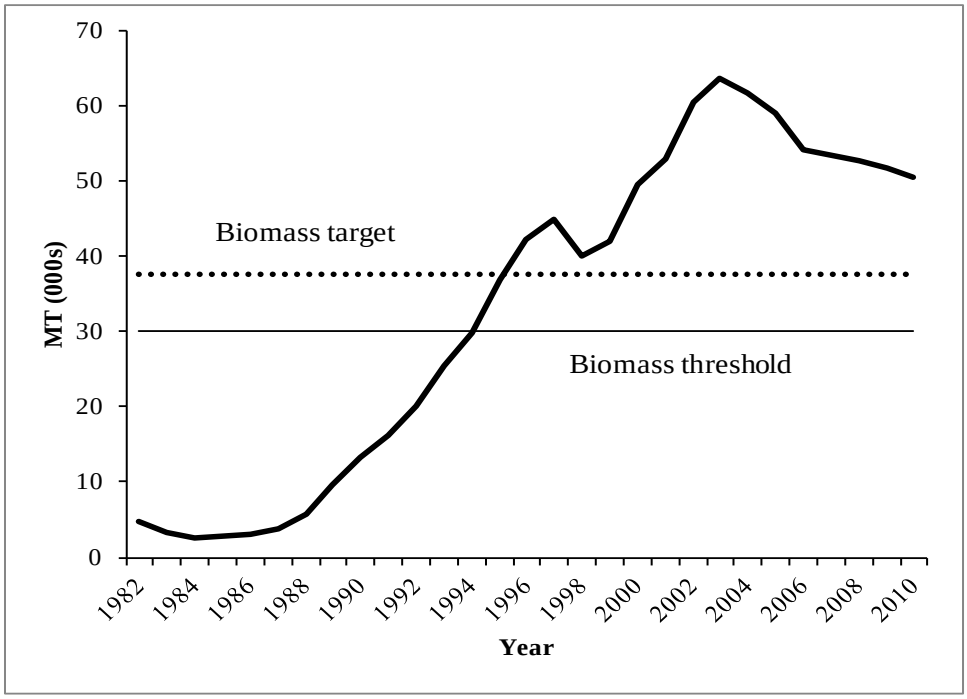


Figure 7. Trends in female spawning stock biomass, 1982 to 2010, from the 2011 catch at age model results.



APPENDICES

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